

VISIT...

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The Eye

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A. Outer Fibrous (Supporting) Layer:

① Cornea ($\frac{1}{6}$ of fibrous coat): (5-layers).

1. Non-Keratinized stratified sq. epith. (5-6 Ls.)

② Basal Layer = cub. or col. cell resting on a straight b.m. They show mitotic figures (high regenerative power) as long as the b.m. is intact.

③ Intermediate Layer = 3-4 Ls of polyhedral cells & free unmyelinated nerve endings (for protection)

- The superficial L. = flat cells & microvilli to retain a film of tears to keep it wet.

2. Bowman's memb. = [Ant. limiting memb.]

= the b.m. of the epith. • Thick $\rightarrow$ strength & stability.

• Non-cellular = collagen fibrils • protect against infection

• Cannot regenerate, if injured $\rightarrow$ corneal opacity.

3. Substantia propria:

about 60 parallel collagen bundles separated by fibroblast like cells = Keratocytes in rows embedded in ground substance rich in proteoglycans [lumican] to maintain their arrangement.

4. Descemet's memb.:

- represent the b.m. of the corneal endoth.

- Non-cellular = fine interwoven collagen fibres.

5. Endothelium := s. sq. endoth.

Functions: 1. maintain Descemet's memb.

2. pump Na^+ into the ant. chamber passively followed by Cl^- & H_2O

This keeps optimum state of corneal hydration for maximal transparency.

Factors Causing Corneal transparency:

1. It is avascular.

2. Regular arrangement of collagen lamellae.

3. The lamellae, cells & matrix have the same refractive index.

4. The epith. is non-keratinized.

5. minimal hydration of cornea.

6. Unmyelinated free nerve endings.

* Lasik surgery: Laser can change corneal curvature to correct vision.

* Microvilli (film of tears) keep the cornea wet to avoid ulceration.

* Injury of the ant. limiting memb. [Bowman's memb.] $\rightarrow$ corneal opacity.

* Corneal transplantation is usually successful (avascular)

[2] - Sclera: (post 5/6 of the Fibrous coat)

Opaque, formed of type I collagen bundles in various directions + fibroblasts + elastic fs. Extraocular ms are inserted in its ant. part. Relatively avascular.

Changes at the Corneo-scleral junct? [Limbus]

1. Conjunctival epith. = non-kerat. st. sq. epith. Stem cells of stratified epith are concentrated at the limbus.
2. Bowman's memb is replaced by subconj. c.t.
3. The collagen bundles become irregular e' appearance of canal of Schlemm.
4. microvasculature of the cornea appear at the limbus.
5. Descemet's memb. & endothelium are replaced by trabecular meshwork e' channels lined e' irregular endoth. they drain aqueous humor from the ant. chamber to canal of Schlemm.

Refractive Media of Eye

= the transparent media through w light passes to reach the retina.

[1] - The Cornea:

[2] - Aqueous humor:

- transparent fluid in the ant. & post. chambers.
- Similar to plasma [in its inorganic ionic content] but e' less total ptn. (0.1%)
- Secreted by: the inner L. of epith. covering the ciliary processes.
- Circulation: passes from the post. chamber through the pupil to the ant. chamber
→ iridocorneal angle → spaces of Fontana → Canal of Schlemm → scleral vs

Glaucoma = ↑ intraocular press. due to impaired drainage of aqueous humor. If not treated → press on optic n. fs → degeneratⁿ, gradual loss of vision.

[3] Vitreous body:

= transparent mucoid c.t.

- present behind the lens in the vitreous chamber.
 - Contains Vitreous humor = 99% H₂O + hyaluronate & small amount of collagen type IV + cells
 - The only cells present are macrophages + hyalocytes → form Hyaluronate + collagen
- Functⁿ: supports the lens anteriorly & the retina posteriorly.

4. Lens:

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Avascular & transparent structure. **Ciliary Zonule** is inserted in its capsule to join it to the ciliary body. Formed of:

a. **Lens Capsule**: thick, homogenous, rich in collagen (type IV) + proteoglycans. Covers the lens & support lens epith.

b. **Subcapsular epith**: 1 layer of cuboidal cells only on the ant. surface of lens. Cells at lens equator divide to allow growth of lens (periphery)

c. **Lens Fibres**: = elongated cell that develop from stem cells in lens epith. w lose their organelles & nuclei & become filled w ptn Crystall. specialized for light refraction.

Cataract = loss of lens transparency due to denaturation of crystallins.

Presbiopia = " " " elasticity in old age → loss of accommodation for near vision.

B. The Middle (Vascular) layer

1. The Iris

def.: the ant. part of vascular layer perforated at the centre by the pupil.

- **Its ant. surface**: irregular non-continuous L. of packed fibroblasts & melanocytes & interdigitating processes.

- **Its post. surface**: covered w 2 layers of pigmented epith. continuous w that on the ciliary processes.

- **Stroma**: loose vascular pigmented c.t. w contains → Constrictor pupillae & dilator " ms.

* **Functions**: 1. Controls pupil size & amount of light.
2. blocks entrance of light (abundant pigment) except at pupil
3. give color of eye.

Albinism: The iris has no pigments. Its pink color is due to light reflected from stromal bl. vs.

2. The Ciliary body

= Vascular c.t. contains pigment cells + Ciliary muscles + elastic fibres.

• **Ciliary epith** = 2 layers of low col. cells:

[Out. layer: (towards c.t.) is pigmented.
Inn. " : (" surface) " non- "]

• **Ciliary muscles**: sm. ms inserted on the sclera. The arrangement of the fibres → reduces the size of the ciliary body on contract? → tension on the zonule.

• Ciliary processes: finger like projections from the med. side of ciliary body covered e' ciliary epith. & contains capillary loops from w aqueous humor is secreted.

Functions: (1) Form aqueous humor. [by the non pigmented L on the processes]
(2) Accomodation for near vision (ciliary ms.)

3. The Choroid

lies bet. retina & sclera: Formed of:

(a) Suprachoroid lamina [SCL]:

= c.t rich in pigment cells + fibroblasts + elastic fs.

(b) Choroido capillaries = fenestrated capillaries to nourish the out. part of the retina.

(d) Bruch's membrane: Acellular memb. = 5 layers

- a middle layer of elastic fs e' collagen fs on either side.

- The outermost layer = the b.m. of the choriocapillaries.

- " inner " " = " " " pigmented cells of retina.

F - It act as a retinal barrier to limit entrance of microbes from the fenestrated capillaries of choriocaps. to the outer part of retina.

The Inner Nervous Layer [Retina]

have 3 types of cells

↓
Neurons

↓
Neuroglial cells

↓
pigment cells.

Formed of 10 layers:

① Pigment Cell Layer:

Single layer of low cot. cells e' basal rounded nuclei resting on Bruch's memb.

- The inner part: contains melanin pigment.

EM have basal mit. rER, s.ER, lysosomes

- " apical microvilli w interdigitate e' rods & cones

- The lat. walls are joined by Z. occludens, Z. adherens, desmosomes & gap J.

Functions:

1. share in formation of Bruch's memb.

2. Melanin absorbs extra light to prevent reflections w

3. phagocytose old discs shed by rods

4. estrification of vit. A (by s-ER) to regenerate retinoids

5. Form bl. retinal barrier.

In Retinal Detachment: the pigmented epith. is firmly attached to Bruch's memb. & the choroid, while the other nine layers are separated.

[2] Rods & Cones layer =

dendritic processes of rod & cone cells = highly modified cilia

[3] Outer limiting membrane =

Junctional complexes bet. rods & cones & Müller cell processes.

[4] Out. Nuclear Layer :

Contains nuclei of rod & cone cells [1st Order Neurons]

[5] Out. Reticular [plexiform] L :

Contains synapses bet. axons of rod & cone cells & dendrites of bipolar n. cells & horizontal cells.

[6] Inner Nuclear L. :

Contains cell bodies & nuclei of 4 types of cells :

(a) Bipolar n. cells [2nd Order N.] : they synapse & axons of rod & cone cells

(b) Horizontal cells :

Their processes extend horizontally in the plexiform layers to integrate impulses from photoreceptors over a wide area of the retina.

(c) Amacrine cells :

(d) Müller cells = Neuroglial supporting cells. Their cell bodies are present in inner nuclear L. Their long processes extend to the out. limiting memb. Also, microglia are scattered throughout the retina.

[7] Inn. Reticular L. :

Where axons of bipolar cells synapse & dendrites of ganglion cells. Both synapse & processes of amacrine cells.

[8] Ganglion Cell Layer :

Contain few large nerve cells [3rd Order N.]

[9] Optic nerve fibres L =

= unmyelinated axons of ganglion cells & no neurolemma (cannot regenerate)
The axons come out at right angle $\rightarrow$ optic nerve.

[10] Inn. limiting memb.

formed by tight junctions bet. the ends of processes of Müller cells.

Rod & Cone Cells

The 1st order N. in the visual pathway. Formed of :

- Cell body (contain nucleus) • dendritic process (out. & inner segment)
- central process (axon).

	Rod Cell	Cone Cell
N ^o	70 - 120 million	about 7 million
Out. Segment	cylindrical (rod)-shaped - contains flattened discs w contain the visual pigment rhodopsin - discs are phagocytosed by pigment cells	cone shaped. - discs are infrequently shed off & phagocytosed by pigment cells
Inn. Segment	- connected to the outer segment by constriction (contain cilium) - Site of ptn. synthesis (rich in mit., rER & G.A).	
Outer fibre	- connects inner segment to the cell body.	absent (only slight constriction)
Cell Body	- contains the nucleus & sends an inner fibre (axon) w end by <u>spherule</u> } <u>pedicle</u> both synapse & dendrites of the bipolar nerve cells.	
Functions	- Vision in dim light. (by night) black & white	- Bright light, colored vision & high visual acuity [the only receptors in fovea centralis].
Clinical Notes	- Defecuity of vit. A → " " rhodopsin → night blindness	lack of iodopsin in the cones → Color blindness.
Site	- mainly peripheral	- mainly central

Macula lutea (yellow spot) = yellow depressed spot opposite to centre of the lens has fovea centralis in its bottom.

Fovea Centralis:

The area of best visual acuity as At this area:

1. except for photoreceptor, most of the layers are reduced or absent.
2. Have cones only.
3. Highly transparent (no bl. vs.)

Macular degeneration:

Age related → blindness in the centre of the visual field.

Accessory Structures of Eye

Formed of:

① The Eye lid

1. Thin skin: e' fine hairs but no fat.

The lid margin contains 2-3 rows of eye lashes.

e' → apocrine sweat gls. = gls. of Moll.

→ sebaceous gls. = gls. of Zeiss.

2. Orbicularis Oculi & Levator palpebrae = skeletal ms.
(facial expression ms.) (opens the eye)

3. Tarsal plate = dense c.t. w contains Meibomian's glands = modified sebaceous gland. Its oily secretion covers the tear film & its evaporation.

4. Palpebral Conjunctiva.

[Infl. of gls. of Moll → chalazion while infl. of gls. of Zeiss → Stye.]

② Conjunctiva

- transparent mucous memb.: 2 parts: Bulbar conjunctiva that covers the sclera & is reflected → to line the eye lid → palpebral conj.
- formed of Stratified col. epith. e' goblet cells resting on b.m. + lamina propria. At the limbus, the epith. changes gradually into str. sq. epith. e' no goblet cells.
- Function: mucous formed by goblet cells, form part of the tear film → to protect the epith. of ant. part of the eye.

[Inflammation of conj. → redness & watering of eye, so called Pink eye]

③ Lacrimal Apparatus

• The lacrimal gland:

Comp. tubulo-alveolar serous gl. w secrete tears. The acini are lined by Col. cells and surrounded by myoepithelial cells.

• Lacrimal canaliculi:

w drain the tears. lined e' st. sq. epith. →

• Lacrimal sac:

dilated part. lined e' ps. st. col. cil epith. →

• Nasolacrimal duct:

drains tears to nose " " " " " "

[Stenosis of the canaliculi or obstruction of the nasolacrimal duct →

Obstructⁿ & infl. of the lacrimal sac.]